DETERMINATION OF STRESS CHARACTERISTICS OF EARTH FORMATIONS

ABSTRACT

A method for determining the maximum and minimum horizontal stresses of formations surrounding a borehole includes the following steps: suspending a logging device in the borehole; transmitting sonic energy from the logging device to establish flexural waves in the formations; receiving, at the logging device, sonic energy from the flexural waves, and producing, from the received sonic energy, measurement signals at a number of frequencies; determining, at the number of frequencies, the fast and slow flexural wave velocities in the formations, to obtain fast and slow flexural velocity dispersions; establishing a model of formation stresses in which stresses of a loaded state are represented by the sum of an omnidirectional hydrostatically loaded mean reference stress, a vertical stress perturbation, and maximum and minimum horizontal stress perturbations; establishing an inversion model that includes inputs from the fast and slow flexural velocity dispersions and also includes unknown horizontal perturbations of the model of formation stresses; deriving, from the inversion model, estimates of the maximum and minimum horizontal stress perturbations; and determining, from the estimates of the maximum and minimum horizontal stress perturbations and the mean reference stress, estimates of the maximum and minimum horizontal stresses of the formations.